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BUILDING AND SUSTAINING THE SAFE WORK ENVIRONMENT AT VEDANTA LTD. SESA GOA IRON ORE BUSINESS

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ABSTRACT

Sesa has got Iron ore mining operations in Goa and Karnataka and a value added business namely manufacturing of Pig Iron, Met coke and Power. As part of this study only the mining operations of Goa are covered. During the year 2015-16 Sesa Iron Ore Business started its journey towards Zero Harm, which means no harm to employees, community and other stake holders surrounding our operations w.r.t Safety, Health and Environment. The management identified the transportation of ore by trucks as the most hazardous activity. The management also undertook the project of reviewing the hazard identification and Risk assessment. Various safety initiatives were taken, most important being the training of all the drivers in defensive driving. The management again reviewed the HIRA post undertaking these initiatives. It was observed that the risk levels significantly came down from intolerable risk to moderate risk..

SESA GOA IRON ORE – CORPORATE PROFILE

Sesa's genesis dates back to the year 1954 when Baron Ludovic Toeplitz landed in Goa and formed a company called Scambi Economici SA Goa with one mining concession of Orasso Dongor in North Goa.

In 1955, the company was renamed Sesa Goa Limiteda and was bought over jointly by Gewerkeshaft Exploration e Bergbau and by Ferromin S.p.A. of Italy. In 1979, with the amalgamation of Sesa Goa and Mingoa, fully owned by Finsider S.p.A. of the IRI Group, Sesa Goa Private Limited was formed. This company went public in 1981 with 60% shares with Indian shareholders and 40% held by Finsider International.

This eventful journey saw Sesa Goa grow from a mining company with one mining concession to mining operations in other areas across the country. The Company expanded

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its operations with widespread interests in shipbuilding, pig iron and metallurgical coke and acquired prestigious clients in the country and abroad, earning a reputation for quality and timely delivery and optimal safety standards. The Company also sought and achieved a position as an environment-friendly concern winning several accolades in the process.

In 1996, Mitsui & Co., Japan bought over RIVA's 51% equity in Sesa Goa Ltd. Mitsui & Co. has operations across the globe providing comprehensive services and capabilities to manufacturing and service industries in a range of business sectors.

In April 2007, Vedanta, through its wholly-owned subsidiaries, bought over a 51.0% equity stake in SGL.

1.1 Background

Sesa has got Iron ore mining operations in Goa and Karnataka and a value added business namely manufacturing of Pig Iron, Met coke and Power. As part of this study only the mining operations of Goa are covered.

The typical mining operations in Goa consists of following activities:

1. Exploration
2. Mining
3. Beneficiation
4. Transportation to jetty by trucks
5. Loading of ore in to barges and transportation by barges to port
6. Loading of vessels for export of Iron ore.

The management of Sesa believes that Safety, Health and Environment is of prime importance and ensures commitment towards the same the company is certified to ISO 14001 (Environment Management System), OHSAS 18001 (Occupational Health and Safety Management System). It also has its own sustainability Guidelines called as Vedanta Sustainability Governance System which is audited by third party.

During the year 2015-16 Sesa Iron Ore Business started its journey towards Zero Harm, which means no harm to employees, community and other stake holders surrounding our operations w.r.t Safety, Health and Environment.

The organisation has taken various objectives to achieve this objective.

- The score card for business plan has 20% weightage for HSE and the same is linked to the individual unit performance
- Leading and lagging indicators: Each business unit has to improve and achieve targets to identify leading indicators such as near miss, unsafe act and unsafe conditions, 100% alcohol checks, HSE training and awareness, HSE audits, 100% compliance, Implementation of wash pledge at all locations.
- The business has also categorised various lagging indicators. Occurrence of such indicators and repetition of other would result in losing score of the business. For instance, the HSE score would be zero if the business reports fatality, environment incident of category 4 or 5, legal non-compliance, repetition of HIPO incident, etc.
- All the individual or unit KRA's are in line with the Business KPI. The same is measured, monitored and reviewed on regular basis.
- Visible Felt Leadership is also part of the system and a schedule for the same is developed for all the department heads right up to the CEO level.

- Training and awareness forms a very important part of such an important intervention. The message of zero harm is communicated to all employees whether company or contractor through various forums and at numerous times.

Table 1: *Sustainability Score Card for Sesa Goa Iron Ore for the Year 2015 – 16*

Parameters	IOG Target
Reporting of USA/USC	1600 nos. in a month for Units
Near miss Reporting	16 nos. in a month
Alcohol Checks	100%
Alcohol Checks	100%
HSE Training	100% induction &1 on a specific topic in a month
HSE Audits	1 in a month
Compliance (Mines Act, Envt Laws and Factories Act.etc.)	100% compliance
WASH Initiative (Hygiene Audit)	1 in a month
VFL compliance	Minimum 60% compliance to schedule.

The Management has felt the need of further improving the system in place and thus achieve the objective of Zero harm.

1.2 Scope

The scope of the study is all the mining operations of Sesa Goa Iron Ore, in Goa.

1.3 Objective

1. To identify the topmost hazard in the mining operations.
2. To improve the defensive driving capacity of the drivers.

METHODOLOGY

The study used both primary as well as secondary methods of data collection. The primary data mostly has been collected with oral interviews with employees and questionnaire. The secondary data is collected based on research articles on internet.

2.1 Theoretical Model

There are various theoretical models which talks about the learning process for instance the Phases of teaching by Philip. W. Jackson. This particular model talks about three stages / phases of teaching i.e pre- active stage, inter active stage and post active stage.

Two principle types of learning are behavioural learning theories and cognitive learning theories. There are Three models of teaching anchored on cognitive learning theory namely Discovery learning of Jerome Bruner, Reception learning of David Ausubel, Events of Learning of Robert Gagne.

In the current study, the cognitive learning theory is adopted. This theory is Concerned with human learning in which unobservable mental processes are used to learn and remember new information or acquired skill. In particular, the Reception learning of David Ausubel.

2.2 Identification of Top Hazards in Sesa Iron Ore Goa Mining Operations

As part of OHSAS 18001 management system, all the mining units of Sesa goa iron ore have carried out **Hazard Identification and Risk Assessment (HIRA)** for its activities. Based on the procedure of HIRA based on consequences, probability, exposure, and risk matrix the top 10 hazards were identified.

2.2.1 The Top 10 Hazards Identified are as below:

1. **Transportation of iron ore by tipper truck**
2. Covering and uncovering of tarpaulin
3. Drilling and balsting
4. Pumping/ dewatering
5. Waste dumping
6. Excavation and loading
7. Barge loading Operation
8. E&I Breakdown Maintenance of Equipment
9. Mechanical Breakdown Maintenance of Equipment
10. Moor rope tying

The '**HIRA**' of all the above mentioned activities was repeated and fresh scores were given.

Once the hazards are identified the next step is **Risk Assessment.**

2.3 Risk Assessment

The following criterions are considered to come out with Risk Levels.

Consequences: Ratings are fixed for different types of consequences. Maximum rating is 10 for a consequence which may result to several fatalities and minimum rating is 0.1 in case the consequence is small injury. Details as below:

Table 2: *Consequences*

Consequence	Rating	Detailing
Several dead	10	-
One dead	7	-
Significant chance of fatality	3	-
One permanent disability/less chance of fatality.	2	Amputation, permanent impairment, deafness, cancer, etc.
Many lost time injuries/serious injury	1	Serious fracture, serious burns, respiratory /nervous disorder, heart problem, allergy,

		kidney/liver disorder, asthma, loss of memory, hypertension, hepatitis, etc.
One lost time injury	0.5	Deep cuts, eye injury, face injury, head injury, health disorder requiring offsite medical attention, eye irritation, vomiting, diarrhoea, jaundice, etc.
Small injury	0.1	Cut, minor burns, minor sprains in joints, minor bruises, minor health problems requiring first aid treatment, back pain, body pain, headache, etc.

Probability: Rating for probability is given based on assumption that how often the event / hazard may occur. Details as below:

Table 3: *Probability*

Probability	Rating
May well be expected	10
Quite possible	7
Unusual but possible	3
Only remotely possible	2
Conceivable but unlikely	1
Practically impossible	0.5
Virtually impossible	0.1

Exposure: Rating is given on how much time frame the person or people are exposed to the hazard. Maximum rating is 10 for continuous exposure and minimum rating is 0.1 for exposure once in 10 years. Details as below:

Table 4: *Exposure*

Exposure	Rating
Continuous	10
Frequent (daily)	7
Seldom (weekly)	3
Unusual (monthly)	2
Occasional (yearly)	1
Once in 5 years	0.5
Once in 10 years	0.1

Calculating risk levels: The score of each activity is arrived at as per the ratings given in each criteria are multiplied i.e. ratings of consequences*rating of probability * rating of exposure. The score is compared with the score given in below mentioned Risk matrix and categorised as Trivial Risk, Acceptable risk, Moderate risk, High risk and Intolerable risk.

Risk matrix: Rating is given based on risk level of particular activity. It ranges from Trivial risk to Intolerable risk. Details of rating as below:

Table 5: *Risk Matrix*

Score	Risk level	Action required
0.001 - 0.1	Trivial Risk	No action required
0.125 - 2.1	Acceptable Risk	Solution or improvement that impose no additional cost burden.Monitoring is required to ensure that controls are maintained
2.5 - 50	Moderate Risk	Efforts that should be made to reduce the risk but the cost of prevention should be carefully measured and limited.Risk reduction measures should be implemented
60 - 300	High Risk	Work should not be started until the risk has been reduced. Considerable resources may have to be allocated to reduce the risk and where risk involves work in progress, urgent action should be taken
343 - 1000	Intolerable Risk	Work should not be started until the risk has been reduced. If it is not possible to reduce the risk even with unlimited resources, work has to remain prohibited

The actions required in case of each level of risk is mentioned in the above mentioned table. For instance, the activity should not be started in case the activity has a high risk or an intolerable risk. If the risk levels are not able to be reduced in such case the activity should be prohibited.

The HIRA exercise was carried out without operational control. The results of the same are given in **Annexure 1.**

2.4 Risk Level for Transportation of Iron Ore by Trucks

The HIRA exercise shows that the activity of Transportation of iron ore by tipper truck is the top most risk across all the activities and the risk levels are high risk of Public and Intolerable risk to Driver.

Table 6: *Risk Level for Transportation of Iron Ore by Trucks*

Activity	Personal at Risk	Probability	Exposure	Consequence	Score	Risk Level
Transportation activity	Public	7	7	3	147	High
	Driver	7	7	7	343	Intolerable

This requires the business to have in place various safety interventions so as to reduce the risk levels to moderate or trivial levels.

2.5 Improvement Initiatives

2.5.1 To Improve the Defensive Driving Capacity of the Drivers

It is evident from the HIRA exercise that the driving skills and knowledge about legal requirement while driving is the main cause for making the activity of Transportation of iron ore by tipper truck the most hazardous amongst all the other activities. Most of the drivers involved in this activity are migrant labours and come from states like Jharkhand, Bihar, Orissa.

The training of these drivers on aspects of defensive driving was coming out to be the most important tool to reduce the score in HIRA and bringing it down in acceptable levels.

2.5.2 Participants for the Training

It was decided to impart training on defensive driving to significant number of truck drivers involved in mining operations. The effort was towards inculcating safe driving and road safety culture in our drivers. **Institute of Road Traffic Education (IRTE)** was identified and collaborated with, to train Drivers on Defensive Driving techniques. All the transportation contractors were communicated to depute their drivers for the defensive drivers training. The contractors were informed about the need of this training with the context of frequent road blockages, road accidents, unsafe driving practises observed on the roads. It was imbibed on their mind that such in discipline was bringing bad name to the industry and which is not good for the business in long term. The training was mandatory for all drivers without which the gate pass to enter the mine was not renewed. Around 767 drivers were selected for the training out of which around 200 were company employees and others contract employees.

2.5.3 Educational Qualification of the Participants

All the company employees (drivers) are ITI qualified. Most of the contract drivers have undergone only primary education and coming from a very poor back ground. They are predominantly from the states of Jharkhand, Orissa and Bihar.

2.5.4 Training Structure

The training was one full working day i.e 8 hours. The programme was conducted by two faculties from IRTE. The training modules comprised of power point presentations, safety videos, signage's, group exercises and interactions. All the drivers were put through an initial as well as post training.

2.5.5 Change in Participant's Capability Post Training

All the 767 participants were subjected to pre and post training questionnaire. The questionnaire accessed their knowledge about:

- Rules and Regulations,
- Various Signage's,
- Various Behavioural Issues.

The awareness levels of all the participants pre training was found to be very poor. Almost all the drivers scored less than 60% in their pre training test and out of them a substantial no of participants (487 nos.) scored less than 40% marks.

The post training test showed a marked improvement in their performance. All the participants scored more than 60% and 418 participants scored above 80%.
Details of their score are as mentioned below:

Table 7: *Score Statistics*

S.No.	Score range	No. of drivers in score range pre training	No. of drivers in score range post training
1	0 - 20	106	0
2	21 - 40	381	0
3	41 - 60	269	0
4	61 - 80	8	349
5	81 - 100	3	418

2.5.6 Feedback of the Participants on the Use and Relevance of the Training Course

In all 767 drivers were trained in defensive driving programme conducted by IRTE. Around 134 participants were randomly selected out of 767 (around 17%)to carry out a survey to find out the use and relevance of the training course.

The participants were asked to give feedback on following points:

- **Content of the course:** The participants were asked to give ratings on a scale of 1 to 5 where 1 means Very Poor and 5 means Excellent.
- **Time allotted for the course:** The participants were asked to give ratings on a scale of 1 to 5 where 1 means Very Poor and 5 means Excellent
- **Instructor knowledge about the subject:** The participants were asked to give ratings on a scale of 1 to 5 where 1 means Very Poor and 5 means Excellent
- **Illustration by practical examples:** The participants were asked to give ratings on a scale of 1 to 5 where 1 means Very Poor and 5 means Excellent
- **Was the training relevant:** The participants were asked to give ratings on a scale of 1 to 5 where 1 means Very Poor and 5 means Excellent
- **Will they recommend others to undergo training:** The participants were asked to give feedback as 'Yes' or 'No'

Details of feedback obtained for above questions;

Table 8: *Feedback Statistics*

Questions	Very Poor	Poor	Good	Very good	Excellent
Content of the course	Nil	Nil	4	28	102
Time allotted for the course	Nil	Nil	15	62	57

Instructor knowledge about the subject:	Nil	Nil	Nil	8	126
Illustration by practical examples	Nil	Nil	8	49	77
Was the training relevant	Nil	Nil	Nil	10	124

- It is evident from the survey that Out of 134 sample size a significant amount of participants i.e 102 participants rated the course Excellent in terms of content of course
- The time allotted for the course was found very good by 62 people and excellent by 57 people.
- 126 people rated the instructor's knowledge as Excellent
- 77 participants rated the programme Excellent in terms of giving illustrations and examples to explain a context
- 124 participants gave Excellent rating to the relevance of training and balance 10 rated it as very good.
- All the participants have said that they will recommend the course to others.

2.5.7 Focus Group

A meeting was organised involving the logistics in-charges of all the mines, mines managers, safety in-charges, transport contractors to get a feedback on the changes in behaviour of the drivers while driving.

Following points came out of the meeting:

- The group felt that this was a very positive step taken by company has improved the road discipline.
- The road accidents and blockages have reduced and as a result the transportation targets are achieved.
- It was felt that more such refresher trainings should be conducted in future for drivers as well as all the employees of the company. (the minutes of meeting attached as **Annexure 2**.

2.5.8 Review of Risk Assessment Post Various Safety Interventions Including Training on Defensive Driving

Various safety interventions were carried out namely,

- Alcohol checks of driver at every entry,
- Gate pass is issued after checking original driving licence and medical examination,
- Speed restriction,
- Traffic signage's,
- Banning of mobile usage,
- Compulsory usage of seat belt, and
- Most importantly the training provided on defensive driving.

The risk assessment of the transportation activity was reviewed post the training session and other above mentioned interventions and it was observed that the risk levels from this activity has reduced as mentioned in below table to moderate levels.

Table 9: *Risk Levels after Control Measures*

Activity	Personal at Risk	Probability	Exposure	Consequence	Score	Risk Level
Transportation activity	Public	2	7	3	42	Moderate
	Driver	1	7	3	321	Moderate

The details of risk assessment exercised is attached as **Annexure 3.**

CONCLUSION

The findings of this study are:-

- As per the hazard identification and risk assessment carried out it was found that the the activity of Transportation of iron ore by tipper truck is the top most risk across all the activities. Hazard identification and risk assessment calculations found out that the Risk to public is high and risk to drivers is Intolerable.
- To reduce the risk from this hazard it was decided to take up capacity building of the drivers who are the most important stake holders in the activity. All the drivers were provided with training on defensive driving through a professional training team from IRTE.
- The participants were also assessed on their capability before and after the training. This evident from the results of the tests and based on the feedback given by the participants and also the points which came out of the focus group meeting that the awareness of the drivers involved in transportation activities has improved significantly and this will help in reducing the risk levels of this activity.
- Various other safety interventions were put in place and HIRA process was reviewed. The risk levels have come down from high and intolerable risk (pre training) to moderate risk (post training) for both Public and drivers.

It is also recommended that the management should conduct refresher programmes for the drivers so that their performance on safety will be consistent and improve the safety performance on the roads.

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ANNEXURES

Annexure 1	Details of the HIRA
Annexure 2	Minutes of the Meeting
Annexure 3	Details of the Risk Assessment